Multidisciplinary Micro CT-3D Imaging Facility

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Beamline(s): **X2B**

NSLS studies over the past year:

We scanned 48 specimens on the X2B beamline micro-CT scanner over the past year in two sessions. They consisted of two types of scans, one was to establish feasibility, i.e., could we see the features we needed to see and, if so, what were the optimal scanner conditions needed to achieve this (e.g., photon energy etc). The other type was "production" runs involving quantitative analysis of the microcirculation of a number of rodent organs and pig myocardial biopsies.

A. Feasibility studies:

a) Osmium tetroxide stained dog lung was scanned at 2 μm resolution. This established our ability to clearly resolve the alveoli and the nuclei of the cells lining the alveoli. This is promising in that we may be able to use this approach to quantitate strains in the alveoli.

b) We scanned the pancreas of a rat, which is genetically predisposed to developing a neoplasm in the pancreas. The question was whether we would have sufficient contrast resolution to detect the cancer tissue. The answer appears to be yes, at least in this specimen.

c) We scanned the leg muscle of a mouse, which has a genetic predisposition to fatty accumulation in the muscles. The question was whether we could detect and quantitate the fat content of the muscle cells. The results are not clear-cut as it involves numerical analysis of the grey scale numbers, i.e., it is not obvious to the eye.

d) We scanned a two-year old rat's heart to evaluate the amount of calcification in the coronary arteries. This clearly can be done and we will now proceed with this study.

e) The vasculature of mice with a genetic propensity for developing colonic adenomas and cancers was studied by high resolution scans of intact colons with opacified vasculature. We could clearly identify the new vasculature in the adenomas and their impact on the native circulation. We will now proceed with this technique.

f) Synovial tissue from arthritic joints was transplanted to the skin of 'nude' mice to observe the vascularization of the synovial membrane. For this we needed resolution sufficient to observe capillaries, which are 5 μm in diameter.

B. Production runs:

a) Pig coronary arteries were scanned at 2 μm resolution in order to image the selectively opacified vasa vasorum of the arterial walls. Clear qualitative differences are apparent between normal and hypercholesterolemic pigs. These vasa vasorum were also measured in terms of cross-sectional area as a function of distance along the vasa. This information was subjected to fluid dynamic analysis to establish the pressure drop along those vasa. We could then look at the implications of the heart rate and radial location of the vasa within the arterial wall (which is under radial compression due to the arterial blood pressure contained by the wall). Vessels down to 10 μm diameter were imaged and analyzed in this study.

b) Kidneys of rats, which were subjected to acute or chronic interventions, were scanned to establish the interventions' impact on the microvascular geometry within the kidney. Some were subjected to lidocaine and others were subjected to ureteral obstruction prior to removal of the kidneys for scanning.

c) The kidneys of genetic "knock out" mice were scanned to quantitate the impact of the genetic defect on the microcirculation in those kidneys.

d) Porcine myocardial microcirculation was imaged to establish the impact of hypercholesterolemia at the terminal arteriolar level.